BEAUFORT REGIONAL ENVIRONMENTAL ASSESSMENT

Annual Progress Report 2011-2012

Canada

September 2012

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Beaufort Regional Environmental Assessment

Building a strong knowledge base to support regulatory decisions on offshore oil and gas activity

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Introduction

In August 2010, the Government of Canada announced the Beaufort Regional Environmental Assessment (BREA), a $21.8 million dollar investment in support of increased research to inform regulatory decisions for potential offshore exploration and development activities in the Beaufort Sea.

BREA is a multi-stakeholder initiative that provides an opportunity for Inuvialuit communities, industry, federal and territorial governments, academia and regulators to prepare for oil and gas activity in the Beaufort Sea by building a regional socio-economic and scientific knowledge base that will: fill regional information and data gaps related to offshore oil and gas activities; and support efficient and effective regulatory decision-making.

BREA's foundation stems from recommendations from the Beaufort Sea Strategic Regional Plan of Action, a multi-stakeholder initiative that was developed in response to concerns raised by the Inuvialuit Game Council (IGC) about Government preparedness for offshore oil and gas development in the Beaufort Sea. BREA has since developed to ensure a coordinated and integrated approach to addressing the challenges of oil and gas activity in the Beaufort Sea and to incorporate lessons learned from the 2010 Gulf of Mexico Deepwater Horizon tragedy.

BREA consists of a research program and working group activities to address priority issues in the region. Seventeen research projects have been funded to-date, based on priorities identified in earlier analyses (Environmental Studies Research Fund Report #163 and a 2011 Data Mining Report prepared by ArcticNet for Aboriginal Affairs and Northern Development Canada) and subsequently refined collaboratively through multi-stakeholder committees. All projects were selected based on their relevance to the priority research areas, as well as their contribution to regulatory efficiency and community preparedness, the two primary goals of BREA.

Separate working groups are addressing issues related to climate change, cumulative effects, information management, oil spill preparedness and response, social, cultural and economic indicators, and waste management.

This report is the first annual report on BREA activities and covers the period between April 1, 2011 and March 31, 2012. The report includes a summary of the research projects funded, and an update on their progress, as well as descriptions of the six working groups and their accomplishments to date. Project metadata and data will be posted to the Polar Data Catalogue (polardata.ca) as they become available while the BREA website (BeaufortREA.ca) serves as a portal for all BREA projects. Communications and community outreach are an important component of BREA, a summary of activities is presented in this report. Finally, the strength of BREA is in its many partnerships between government, Inuvialuit, industry and academia; these partners are listed in the last section of the report.

Research Program

Active Acoustic Mapping of Fish in the Beaufort Sea, 2011-2013

Lead: Louis Fortier (ArcticNet)

This cutting-edge project, led by ArcticNet, will use state-of-the-art fisheries sonar technology to map the distribution and abundance of Arctic cod and other fish in the offshore Beaufort Sea during the summer months. Arctic cod is the main food source for seals, whales and birds in the Beaufort Sea Region and this study will be important to supplement existing research into the winter distribution patterns of Arctic cod.

Progress: The first of two field seasons was completed in 2011-2012. Sonar equipment was purchased and installed aboard the Amundsen. From August 27th to October 3rd, the EK60 echosounder was continuously operated while 85 hours of adaptive and 205 hours of opportunistic sonar surveys were conducted in the South Eastern Beaufort Sea and in the Amundsen Gulf (Figures 1 and 2). An almost continuous layer of pelagic fish was observed with the EK60 echosounder in the top 100 m of the water column, along with an occasional layer near the bottom in bathymetric areas ranging from 200 to 400 m. Mean integrated fish biomass was 1.84 x 10-2 kg m-2. Ichthyoplankton net deployments were conducted in the surface layer throughout the same period. In addition to Arctic cod, which dominated the juvenile fish assemblage, sand lance *Ammodytes* sp. and *Arctic shanny Stichaeus* sp. were also found at most stations. In the surface layer, fish standard length ranged from 13 to 42 mm, for an average of 26.35 mm. Rectangular Midwater Trawl net deployments were also conducted in the surface layer, but no adult fish were caught, which suggests that this layer was composed of juvenile fish (age-0). A Target Strength analysis also demonstrated that pelagic fish forming the top layer were smaller than those near the bottom. No schools of adult fish were detected in the Beaufort Sea with the sonar, which suggests that unlike the initial hypothesis, adult Arctic cod do not school near the surface in offshore ice-free areas in September. Surveys to be conducted in 2013 will investigate the assumptions that adult Arctic cod rather school in coastal shallow waters (<25 m) and in the Marginal Ice Zone (MIZ) at this time of the year. The report *2011 Beaufort Sea Active Acoustics Survey for Marine Mammal and Pelagic Fish Detection* is available on the BREA website.

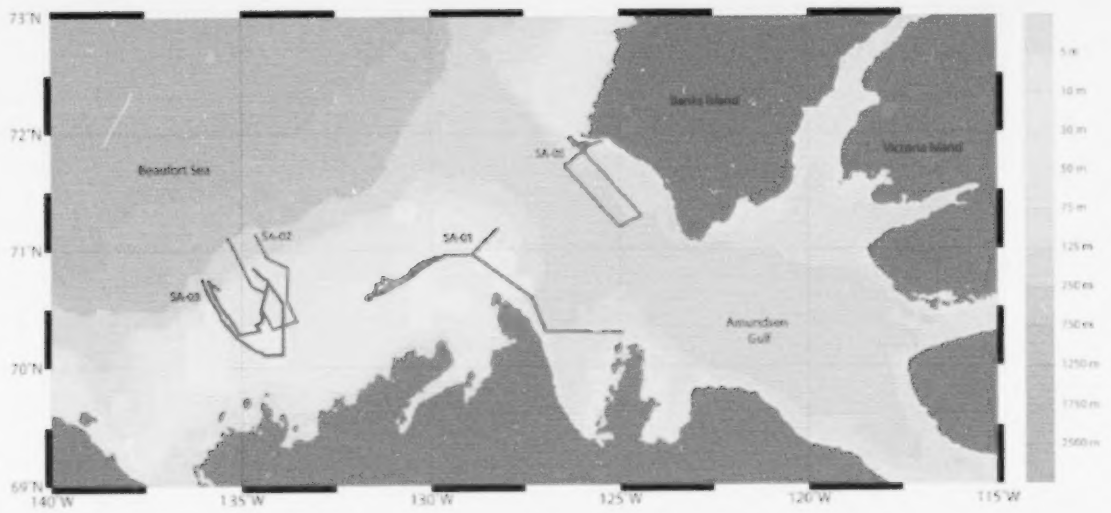

Figure 1. Map of the ship's track during adaptive surveys conducted from September 1st to 29th. Yellow polygons indicate known whale feeding areas provided by Fisheries & Oceans Canada.

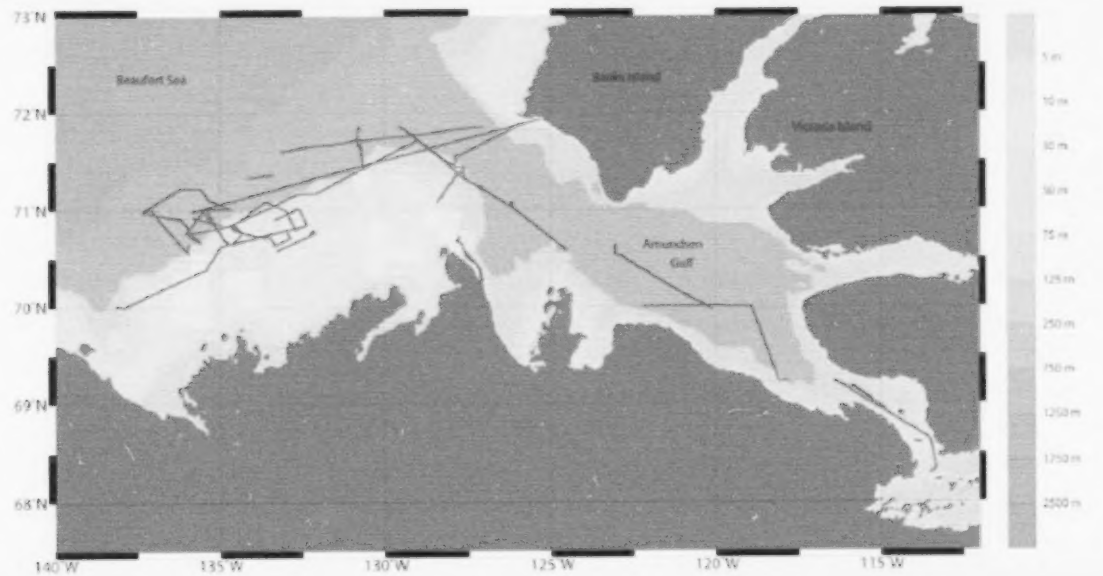

Figure 2. Map of the ship's track during opportunistic surveys conducted from August 27th to October 3rd in the Canadian Beaufort Sea. Yellow polygons indicate known whale feeding areas provided by Fisheries and Oceans Canada.

Impacts of Development in the Beaufort Sea on Fish, their Habitats and Ecosystems, 2011-2015

Lead: Jim Reist (Fisheries and Oceans Canada)

Fisheries and Oceans Canada, in collaboration with six Inuvialuit communities, will conduct a four-year (2011-2015) study that will include a fishing survey in deeper waters (100 to 1000 m) of the outer continental shelf as well as slope areas of the Beaufort Sea. Researchers will study both bottom-dwelling and mid-water fish species, documenting the size of their populations, habitats, diets, roles in the food chain and migratory patterns – something which has never been done before. Increased understanding of the ecosystems on which fish species depend will support environmental assessments and sound decision making regarding fish habitat and offshore oil and gas activities.

Progress: The research plan for the project has been drafted and is under review by Northern stakeholders. Gathering of historical information on fish populations in the Beaufort Sea is underway and will be presented in synthesis reports as well as a geospatial database. The F/V Frosti, based out of Richmond, BC, is secured for the 2012 and 2013 field seasons with an option for 2014. Liaisons with ship owner and ship captain have been undertaken to facilitate gear up, field work and associated logistics. Equipment has been purchased for both field (vessel) and laboratory set up.

Coastal and Marine Bird Usage of the Beaufort Sea Region, 2011-2013

Lead: Myra Robertson (Environment Canada)

The Beaufort Sea Region provides marine and coastal habitat for hundreds of thousands of migrating and breeding birds. Environment Canada will lead this project to identify important nearshore and coastal nesting, feeding and migration areas. The study will compile existing information on coastal bird usage and will identify species, numbers and distribution of birds. A digitized Geographic Information System will be used to identify bird sensitivity areas in the Beaufort Sea based on available information. The information will be valuable to oil and gas developers and regulators through the environmental assessment process to ensure that negative impacts of development on birds are minimized.

Progress: In 2011-2012, coastal and marine bird information was compiled into a database, and areas of importance for various bird species identified. A report has been drafted. Priority research areas were identified. Canadian Wildlife Service holds the geospatial database that contains the information gathered and synthesized as part of this project. The georeferenced database includes all bird species, where information was available. Data was organized into three time periods: early June to mid July (arrival and nesting), mid July to mid August (brood rearing and moulting), and mid August to late September (fall migration). Species densities and ranks of bird use (high, moderate, low) are available for specific areas for each time period. The coastal bird data will be incorporated into the Northern Data Atlas, an online mapping tool that is currently under development (Figure 3). A Canadian Wildlife Service technical report will be published in 2012-2013.

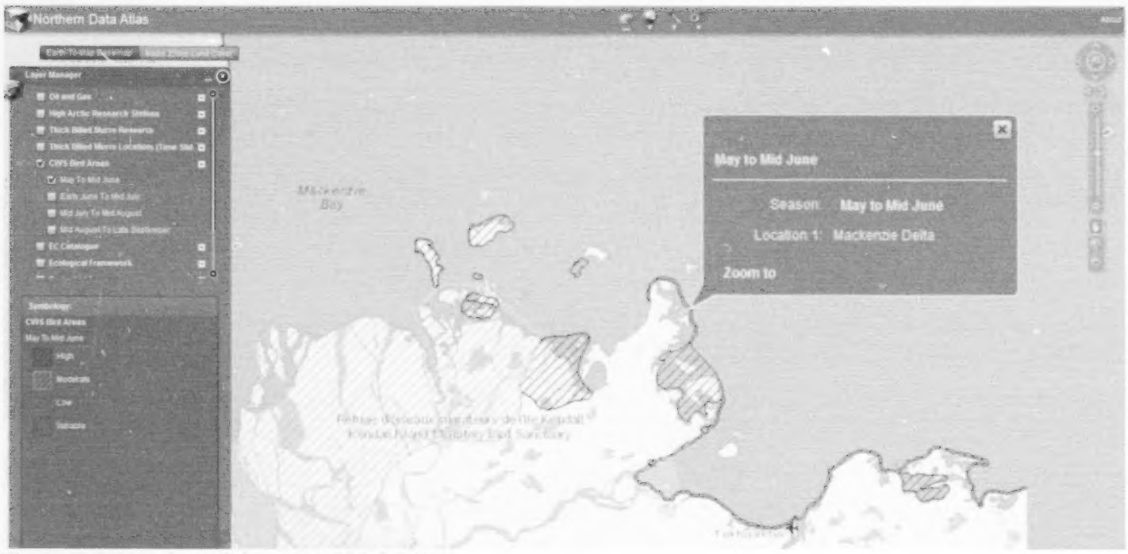

Figure 3. Screenshot of the coastal bird data.

Database and Atlas of the Birds of the Canadian Beaufort Sea, 2011-2012

Lead: Ross Harris (Upun-LGL)

This project will synthesize existing information on offshore bird populations in the Beaufort Sea into a geo-referenced database. The database will include information on the offshore occurrence of birds, species, gender, age, date, location, movement and the data source. This work will complement the coastal bird population project being led by Environment Canada.

Progress: Work on this project has focussed on database design, identification of data sources, acquisition of field data, and incorporation of the field data into the database. Discussions with the Canadian Wildlife Service regarding the database they use for surveys offshore eastern Canada (Eastern Canada Seabirds At Sea, or ECSAS), led to the adoption of that database design for this project. To date, over 20 datasets have been identified, including primarily data collected during bird surveys conducted on recent offshore seismic programs. Several companies and groups have kindly provided data or are in the process of doing so, including GX Technology, Devon Canada, BP, Imperial Oil, ArcticNet, Natural Resources Canada, and Fisheries and Oceans Canada. The data are now being reviewed and incorporated into the CWS ECSAS database design. Presentations on the project were made to the two Wildlife Management Advisory Committees, and to the Inuvialuit Game Council, to update them on the project and to elicit feedback. A final report and the database will be published in late 2012.

Polar Bears in the Deep Offshore Regions of the Beaufort Sea: A Preliminary Study to Estimate Distribution and Density in Previously Under-Surveyed Areas, 2011-2012

Lead: Norm Snow (Joint Secretariat)

The potential presence of polar bears in the deep waters of the offshore region of the Beaufort Sea has been a longstanding interest of Inuvialuit communities, but scientific surveys for bears in this region have never been undertaken. This study, being led by the Joint Secretariat, will involve an aerial survey in early March 2012 to document the distribution and density of polar bears in the deep offshore region of the Beaufort Sea. Preliminary estimates of bear density in the offshore region will enable regulators to better understand the potential effects of offshore oil and gas development activities on these marine mammals. At the same time, results from this study will help guide further studies into population structure in this part of the Beaufort Sea, eventually leading to a longer-term understanding of polar bears in the region.

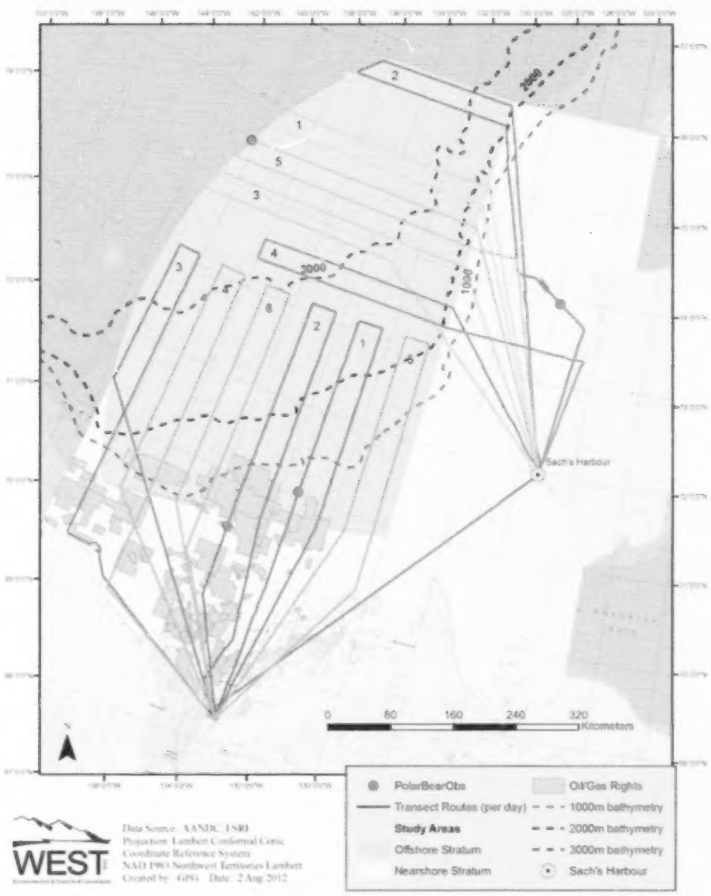

Figure 4. The area surveyed for polar bear was bounded approximately by the 2000 m depth contour on the east, the 1000 m depth contour on the south, a 300 nautical mile limit from Sachs Harbour on the west, and latitude 760 N on the north. A total of 7776 km randomly placed transects were flown in the study area during 21 March to 30 March 2012.

Progress: The aerial survey of polar bears in the offshore region of the Beaufort Sea was conducted over nine days in late March. Two scientific observers and three observers from Sachs Harbour participated in the survey. The crew flew approximately 6,000 km in the offshore: ten East-West transects based out of Sachs Harbour covering the northern portion of the study area, and twelve North-South transects from Inuvik in the southern portion. They also covered 1,000 km in the nearshore, conducting nine opportunistic coastal transects on the way to and from the offshore. In the offshore, a total of 4 polar bears (2 adult females and 2 yearlings) were sighted in two groups on the study area (Figure 4). Outside

the study area in nearshore areas, an additional 5 bears (2 adult females, 1 yearling, 2 cubs of the year) were sighted. Transect logs and data sheets were transferred to West Inc. for analysis. A report, including the analysis and lessons learned to help guide further studies, is currently being prepared.

Biological Data to Assess the Net Environmental Benefits and Costs of Dispersants and In-Situ Burning in Oil Spill Response, 2011-2013

Lead: Ken Trudel (SL Ross)

An important part of oil spill response planning is to develop tools to assist in assessing the risks from oil spills and the benefits of countermeasures (e.g., dispersants, burning) used to fight them. This project will examine traditional knowledge to identify Inuvialuit environmental protection priorities in the Canadian Beaufort Sea. Traditional knowledge will be combined with scientific data to:

a. describe Inuvialuit harvesting and other activities;
b. describe the fish, bird and marine mammal populations upon which these activities depend; and
c. assess the vulnerability of all of these to effects of spills and countermeasures.

Using realistic spill scenarios, this information will be used to illustrate the use of net environmental benefit analysis to assess the merits dispersant and in-situ burning in responding to oil spills in the Beaufort Sea.

Progress: A long list of potential candidate Valued Ecosystem Components (VECs) and support documentation was developed in preparation for a March 2012 Traditional Knowledge (TK) workshop. This was based on analysis of harvesting reports of the Inuvialuit Game Council, Community Conservation Plans and Traditional Knowledge publications on harvesting, and Species-at-Risk reports. A short list of candidate VECs, was developed in the workshop, as well as a working hypothesis for priorities. The workshop identified the Beaufort Sea VECs that communities believe to be critical in spill planning, and for which vulnerability profiles should be developed. An example spill scenario and Net Environmental Benefit Analysis (NEBA) were prepared for use in the March TK workshop and as an aid in communicating about NEBA and vulnerability profiles with stakeholders. The location used as the launch point for the scenario was based solely on the geographic location of oil exploratory drilling in the Southern Beaufort Sea area pre-1990s. A basic scenario was used at the workshop for teaching purposes. Since the workshop, work has begun to analyze more complex scenarios involving above-sea and subsea blowout scenarios.

Overwintering in the Beaufort – Assessing Damage Potential to Vessels, 2011-2013

Lead: Anne Barker (National Research Council)

Vessels containing and/or storing fuel are frozen into ice that is anchored to the shoreline (land-fast ice) throughout the Beaufort region over the winter months. The practice, called over-wintering, has raised concerns in some northern communities about the potential for fuel spills. This project will assess

whether vessels or barges experience any significant damage when overwintering in land-fast ice. The information will be used to make recommendations to Inuvialuit communities and regulators on the best ways to reduce the likelihood of damage to vessels overwintering in ice in the nearshore region of the Beaufort Sea that could pose environmental risks.

Progress: An overview report of historical overwintering activities in the western Canadian Arctic was prepared. This report documents the primary overwintering locations as they pertain to oil and gas activities in the Beaufort Sea, presents advantages and disadvantages of each location, and whether or not damage to vessels occurred while they were overwintering. The report also touches upon overwintering in the MacKenzie River, although this location is more relevant to mining activities. Literature that pertains to the assessment of thermal loading of structures was compiled for subsequent analysis. Satellite imagery of key overwintering locations was acquired, in order to help assess thermal loads in these regions in year two of this project. Meetings and visits to sites of interest were planned for April 2012.

Southern and Northeastern Beaufort Sea Marine Observatories, 2011-2014

Lead: Martin Fortier (ArcticNet)

This initiative will see three oceanographic observatories, each composed of two moorings, established to collect year-round marine observations of the Beaufort Sea using state-of-the-art instruments, including Doppler current meters, sediment traps, ice-profiling sonars, conductivity-temperature sensors and turbidity meters. Researchers will monitor and interpret the information generated on sea ice, ocean circulation and biogeochemical fluctuations throughout the region. The four-year project, led by ArcticNet and IMG-Golder, an Inuit-owned environmental and engineering company, will collect data to gauge the physical conditions and variability of the Canadian Beaufort Sea year over year. This information will provide previously unavailable scientific evidence of oceanic and sea ice conditions, enabling regulators to make informed decisions about potential environmental effects of exploration drilling in the Beaufort Sea.

Progress: The first 3 Moorings were deployed in the fall of 2011 in the EL 446 And EL 449 acreages in the southern Beaufort Sea, roughly 100 nautical miles northwest of Tuktoyaktuk (Figure 5). These deployments are maintaining an existing ArcticNet time series initiated in 2009 in collaboration with Imperial Oil and BP. In the Mackenzie Trough, at the western limit of the Canadian Beaufort Sea, a fourth mooring was deployed in 2011; the fifth will be deployed in 2012 (BR-01-12). The final pair of moorings (BR-03-13, BR-04-13), to be deployed in 2013, will be located off the northwest coast of Banks Island, starting a time series in north-eastern Beaufort Sea where year-round measurements have rarely been obtained.

Figure 5. Location of marine observatories (moorings) installed in 2011 (red triangles), and planned locations for 2012(green triangle) and 2013 (blue triangles).

CanICE – A Sea Ice Information Database and Web-Based Portal, 2011-2014

Lead: Leah Braithwaite (Environment Canada)

Sea ice exerts important seasonal effects on weather and climate, marine ecosystems, the safety of marine transportation, northern communities and offshore resource development and exploitation. Whether preparing policy or regulations, assessing the impacts of activities on ecosystems, designing sustainable infrastructure, or planning and conducting safe and secure shipping, information about sea ice conditions is vital given the variable and harsh Arctic marine environment. Environment Canada, in partnership with several universities, will create a publically accessible database that captures existing information on sea ice features including coverage, concentration, type, characteristics and extreme ice hazards. Access to the database will be through the Polar Data Catalogue. The interoperable database will enable online, open access to historical and current sea ice information and will allow others with sea ice information to add data to this central information source.

Progress: The database schema for a sea ice geo-database has been determined. Initial database specifications have been determined, and communication between the Canadian Ice Service (CIS) and

the Polar Data Catalogue (PDC) databases has been established. Hardware and architecture are now in place to link with the CIS database to the PDC. An inventory of CIS archive holdings has been undertaken, to be completed in spring 2012; digitization of the archive has begun. A Spatial On-Line Analytical Processing (SOLAP) prototype tool has been developed using existing Polar Data Catalogue metadata and research; the examination of data visualization and exploration strategies was undertaken.

Beaufort Sea Environmental Database, 2011-2013

Lead: Ivana Kubat (National Research Council)

Over the years, a significant amount of environmental data has been collected in the Beaufort Sea, but it is widely scattered. Searching for the best available datasets is often difficult. Downloading, extracting and visualizing the information from various sources and file formats is even more challenging and time consuming. The National Research Council of Canada will develop an integrated database for the storage, query and visualization of all key relevant environmental data for the Beaufort Sea. This single-window information source will give regulators access to definitive regional environmental information. The database will be used to determine design ice loads for offshore platforms and marine operations.

Progress: The 2011-2012 year is the first of two years where available Beaufort Sea environmental datasets of interest were linked to the database. New features that were requested by project partners were built and implemented. An interim user manual was prepared and distributed to project partners along with a copy of the database. This is a 2-year project and will be completed in March 2013.

Delineation of Extreme Ridges in High Resolution Satellite-Based Radar Imagery, 2011-2012

Lead: Desmond Powers (C-Core)

This project, led by C-Core, will demonstrate the feasibility of using satellite-based imagery to delineate extreme ridge features in sea ice of the Beaufort Sea. Data collected from ice profiling sonar maintained by the Institute of Ocean Sciences (Fisheries and Oceans Canada) will be compared to high resolution satellite radar images for the detection of these extreme ice features. Knowledge of the spatio-temporal frequency of ice ridges will provide valuable information for engineering design and transportation issues related to oil and gas activities in the Beaufort.

Progress: Using the data available during the timeframe of this study, correlation of keel and satellite data had limited success. In the Upward Looking Sonar data reviewed for this study, 70% of all keels with drafts over 20 m were detected in the period of May to July. Attempting to correlate data with surface features in mixtures of loose floes and open water leads was difficult to perform with any degree of confidence. While surface features were evident in SAR imagery, they were not clearly identifiable compared to features in optical imagery. The availability of high-resolution satellite data has increased

significantly in the past few years, therefore a comparison when the more recent Upward Looking Sonar data (2010 and later) becomes available would yield more favorable results. The final report, *Delineation of Extreme Ridges in High Resolution Satellite-Based Radar Imagery*, is available on the BREA website.

Deep Water Seabed Geohazards, 2011-2015

Lead: Steve Blasco (Natural Resources Canada)

Oil and gas exploration in the deep waters of the Beaufort Sea requires knowledge of seabed stability conditions to ensure safe drilling practices. Under this initiative, the Geological Survey of Canada will conduct a regional assessment of seabed instability conditions, such as mud volcanoes, gas vents and faults, subsea permafrost and the severity of these geohazards. Seabed geohazard research provides baseline knowledge in support of spill prevention and contributes to the preservation of the marine ecosystem and protection of renewable resources. Research findings from this regional assessment will be essential for environmental impact assessments and will support informed decision making in the development of an effective regulatory regime.

Progress: The research for 2011-2012 was focused on acquiring seafloor multibeam and subbottom profile data and seabed sediment samples to map the regional distribution of geohazards within the Beaufort deep water area of current exploration interest. Existing data coverage (2009-2010) was extended into deeper water on the upper slope and to shallow water on the outer shelf to meet the needs for regional coverage. Multibeam and subbottom profile data revealed more extensive submarine landslides in deeper water with 4 slide scars mapped. Other observed deep water instability features included several mud volcanoes, one of which appeared to be actively venting gas. On the outer shelf additional new mud volcanoes were mapped. The Kopanoar feature first observed venting gas in 1979 was venting gas from 7 sites on the crest of the feature. Sediment sample data were acquired for 6 existing piston cores on a transect from the outer shelf down the upper slope. Sediment subsamples were collected in the Geological Survey of Canada's core laboratory in Dartmouth to determine the strength properties and age of both stable and unstable sediments. The 2011 seabed mapping program was successful and exceeded expectations.

INTEGRATED SEA ICE PROJECTS

The following three projects, led by the National Research Council, the University of Manitoba and the University of Alberta are part of an integrated sea ice project that will examine the characteristics of multi-year sea ice. The result will be measurements at the small, medium, and large scale that are brought together to improve our understanding of the properties and behaviour of sea ice in the Canadian Beaufort Sea.

Measuring the Thickness and Strength of Deformed Multi-Year Ice in the Beaufort Sea, 2011-2015

Lead: Michelle Johnston (National Research Council)

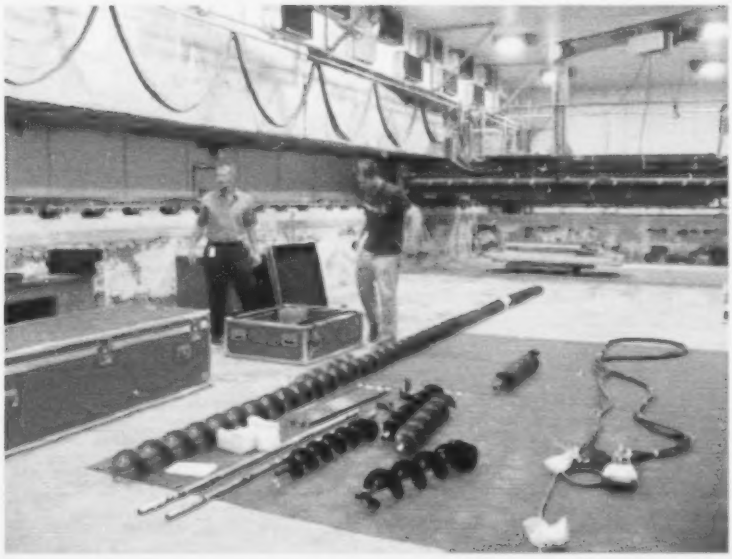

Figure 6. Some of the gear needed for field program. Drill frame is in large red box. The green and red auger shows the depth to which the ice will be drilled (12 m) and tested with the borehole indenter (far right).

Although there is growing evidence that the polar pack is decreasing in extent and thickness, icebergs, ice islands and thick, deformed multi-year ice continue to pose a hazard. This project, led by the National Research Council of Canada, will describe the thickness and strength of extreme ice features in the Beaufort Sea at ice depths (up to 12 m) where no information currently exists. The research will provide information needed to better engineer structures to withstand the impacts of deformed multi-year ice. Increased knowledge of dangerous ice features will also enhance the decision-making capacity of regulators and industry.

Progress: The equipment needed to probe the depths of hummocked multi-year ice was developed in 2011-2012, including a relatively lightweight drill frame and modified borehole indentor system (Figure 6). Additional equipment and materials necessary for measuring ice properties at depth has been purchased. The new equipment continues to be tested and modified at the NRC laboratory and cold room facilities in Ottawa. Preparations were made for the first field season, scheduled for May 2012.

Understanding Extreme Ice Features in the Beaufort Sea, 2011-2015

Lead: Christian Haas (University of Alberta)

Among the most serious challenges to operating in the Beaufort Sea are widely varying sea ice types and severe ice conditions. This project, led by the University of Alberta, will use electromagnetic surveys and drift beacons to perform large-scale, airborne ice thickness surveys to quantify the thickness and regional distribution of multiyear ice and extreme ice features in the Southern Beaufort Sea. The results of this research will improve understanding of how sea ice moves in response to winds and currents, and will contribute to the development of tools to predict ice drift. Being prepared for any and all

eventualities is one of the realities facing regulators and industry contemplating offshore oil and gas exploration and drilling.

Progress: The 2011 project year focused on preparing for the airborne surveys planned in the Southern Beaufort Sea in April 2012 and 2013. Main deliverables were the Integration of an electromagnetic (EM) system into a Basler BT67 aircraft, the purchase of air-droppable GPS beacons, and the preparation of a field plan for the measurements in 2012. The construction of a winch and docking system for the airborne EM instrument was contracted in September 2011 before BREA funds were available. However, the completion of the components has been significantly delayed by the manufacturer and the system is not yet available for surveys in April 2012. Instead, surveys will be performed with a German system. These are scheduled during the period April of 19 to 24, 2012; a field plan has been compiled outlining tentative flight tracks and identifying thick ice targets for beacon deployments. Surveys will be performed from Inuvik only and will focus on the Southern Beaufort Sea. All beacons for the 2012 and 2013 deployments have been purchased, and the first deployments will be performed with a chartered Twin Otter before the performance of the thickness surveys.

Radarsat Mapping of Extreme Ice Features in the Southern Beaufort Sea, 2011-2015

Lead: David Barber (University of Manitoba)

There is growing global interest in marine shipping and oil and gas development in the Southern Beaufort Sea as ice cover in Arctic waters diminishes over the summer months. However, hazardous ice remains a risk to industrial operations in the region. This research will provide regionally relevant information on extreme ice features along the northwestern flank of the Canadian Arctic Archipelago. The University of Manitoba is leading a team of investigators that will use Radarsat technology to detect, monitor and eventually model the distribution and motion of hazardous ice features and their movement over significant oil and gas exploration licenses in the area. This scientific knowledge will be married with information collected by local residents participating in a new community-based pilot program to monitor sea ice thickness.

Progress: During the 2011-2012 fiscal year the main tasks were obtaining a research license through the Aurora Research Institute, the planning of and preparation for field operations, and the acquiring of scientific equipment required to meet project objectives of measuring sea ice properties including ice growth and ablation (ice mass balance); sea ice motion as a function of atmospheric forcing and ocean currents (current profilers, wind monitors, position beacons) and sea ice thickness measurements (a surface based EM induction system). Satellite data acquisition plans were made in cooperation with the Canadian Ice Service to obtain imagery to identify and track extreme features. Preparations were made for a successful first field season April 1-21, 2012, including establishing plans for the community based monitoring program based out of Sachs Harbour.

INTEGRATED MODELING PROJECTS

The following two projects led by Fisheries and Oceans Canada and Environment Canada are part of an integrated project on coupled ocean-ice-atmosphere modeling. The researchers are working together to improve forecasting capabilities of ocean and ice behaviour in the Canadian Beaufort Sea.

Forecasting Extreme Weather and Ocean Conditions in the Beaufort Sea, 2011-2015

Lead: Fraser Davidson (Fisheries and Oceans Canada)

Drilling operations in the Beaufort Sea are increasingly focused on the shelf break between the deep and shallow parts of the Sea – an area characterized by extreme weather events, ocean currents and waves. This research will develop and implement an integrated ocean-wave-ice-atmosphere prediction system to forecast the changing marine weather, sea ice and ocean conditions. This invaluable information will support the Global Maritime Distress Safety System's warnings and information services for the Arctic. It will be equally vital to oil and gas exploration and development by providing forecasts that will inform operations in the Beaufort Sea.

Progress: The project debuted in September 2011. A coordination meeting was held with the project team to develop a modeling study plan. Two postdoctoral fellows were offered positions beginning in April 2012 to conduct the modeling work. The creation of an observation database that will support model validation is under development, and includes all available Canadian Arctic Shelf Exchange Study (CASES) and ArcticNet data. Two computer systems have been improved and implemented to support dissemination of the project output and to develop and run the ocean-ice forecast systems. On the modeling side, tides have been implemented and tested in the model code. The inclusion of wave and ice interactions has started as well as research on ice rheology improvements.

Seasonal Forecasting of Ocean and Ice Conditions in the Beaufort Sea, 2011-2015

Lead: Gregory Flato (Environment Canada)

Predicting the weather days in advance is standard fare in most parts of the country. But for oil and gas companies considering exploration and drilling activities in the Arctic, anticipating what the weather will be like over the coming year is extremely important. This project, led by Environment Canada, will create a high-resolution forecasting system capable of predicting ocean and sea-ice conditions in the Beaufort Sea region from one to twelve months in advance. The research will provide enhanced regional detail in operational seasonal predictions and contribute directly to the development of improved climate prediction products. This will serve both regulators' and industry's operational needs, now and in the future.

Progress: A 12-month multi-seasonal ensemble retrospective forecasts initialized at the start of every month in years 1979 to 2010 was completed. This forecast dataset has been made publicly available over the web. Preliminary results show that skill in predicting overall ice extent peaks in the autumn months (September, October and November), and for those months remains appreciable up to the

maximum forecast range of one year. A novel procedure for calibrating sea ice forecasts to account for differences in modeled and observed sea ice climatologies has been developed and is now being applied.

Working Groups

Climate Change

The BREA Climate Change working group was formed to support efficient and effective environmental assessment and regulatory decision-making as related to aspects of climate change of relevance to offshore oil and gas activities in the Beaufort Sea. Working Group activities will also assist to identify, and recommend actions to fill, information and data gaps related to climate change in the region.

Progress: The report *Oil and Gas Exploration and Development Activity Forecast for the Beaufort Sea 2012 – 2027* was prepared by Lin Callow for the climate change working group to provide context for their study, the cumulative effects working group and the final outcomes of BREA. The report provides a historical perspective on exploration and development in the Beaufort Sea, as well as forecasts oil and gas activities in the Beaufort Sea for the next 15 years.

The Climate Change Working Group awarded Stantec a contract to conduct a study to assess the impacts of climate change on oil and gas activities in the Beaufort. The study will include an assessment report as well as an expert workshop to validate findings. The draft report was completed in March 2012. The workshop and final report will be completed in the 2012-2013 fiscal year.

Cumulative Effects

The Cumulative Effects working group will work towards developing a regional framework that will enable all stakeholders (government, Inuvialuit, industry) to participate and support the process. The framework will establish a Cumulative Effects Assessment method that addresses regional concerns based on identified Valued Components (VCs) and their associated stressors. A regional collaborative approach to developing the assessment framework will provide a consistent approach in project assessments and provide a better means for regulators to ensure that cumulative effects are being addressed.

Progress: A strategic direction and workplan for developing a cumulative effects framework was established. A pilot program is proposed to develop valued components and indicators that have a clear link to oil and gas activity. Potential impacts and mitigation measures will be considered as part of the pilot. Implementation will begin in 2012-2013.

Information Management

The Information Management working group supports coordinated data and information management for BREA. The working group focuses on making historical and new information generated on the Beaufort accessible to stakeholders.

Progress: An updated version of the BREA website, hosted by the Joint Secretariat, was launched with a new look and additional functionality (www.BeaufortREA.ca). The first BREA publications are now available on the website; the website also provides links to related initiatives and publications. Partnerships were developed with the Polar Data Catalogue (University of Waterloo) and Data Assembly Centre Network (University of Alberta and Scholar's Portal) to develop a data archive and online catalogue for BREA metadata and data. A partnership with the Arctic Science and Technology Information System (University of Calgary) was established to create an index of BREA and related publications, including publications relating to the National Energy Board's Arctic Offshore Drilling Review. The data and information management policy was drafted and will be finalized in 2012-2013.

Oil Spill Preparedness and Response

The Oil Spill Preparedness and Response working group was established to improve the ability of government, the Inuvialuit and Industry to respond to a significant spill related to oil and gas activities in the Beaufort Sea.

Progress: The working group initiated two projects in 2011-2012 to improve community preparedness. The Workshop on Dispersant Use in the Canadian Beaufort Sea, was held in Inuvik, NWT on July 26 – 28, 2011. The workshop informed regional stakeholders about dispersants and the implications of including them as a response tool for potential oil spills in the Canadian Beaufort Sea. The workshop explored the use of Net Environmental Benefit Analysis to identify the tradeoffs of using oil spill countermeasures versus not using them. The event provided a venue to help identify paths forward in order to plan for the inclusion of chemical oil spill dispersants in the "toolbox" of spill response countermeasures available to responders in the Beaufort Sea. The workshop report, *Workshop on Dispersant Use in the Canadian Beaufort Sea*, prepared by SL Ross, is available on the BREA website.

A second project was awarded in 2011-2012 to Kavik-Stantec to examine the training requirements associated with potential roles of Inuvialuit in oil spill response. Initial meetings with Inuvialuit, industry and regulators were held in March 2012. A workshop will be held in the fall of 2012 and a report will be produced that will outline the potential roles of community members in oil spill response along with training requirements that would allow for participation in various response roles.

Social, Cultural, and Economic Indicators

The Social, Cultural and Economic Indicators working group was established to develop social, cultural and economic baseline data and indicators for the Inuvialuit Settlement Region (ISR) to identify the impacts associated with oil and gas activity.

Progress: Over the past fiscal year the Inuvialuit Regional Corporation (IRC) has taken the lead on the social, cultural and economic component of the Beaufort Regional Environmental Assessment. This year, the IRC continued to build baseline data with the Government of Northwest Territories (GNWT) Bureau of Statistics; completed the organizing of GNWT Department of Education, Cultural and Employment administrative data and developing the systems to transfer the data on a periodic basis; conducted

research on government programs and services that included interviews with beneficiaries to determine gaps in programs and policies for both , social housing and income support, and economic life of an Inuvialuit Household.

The IRC and Inuvialuit Game Council have jointly hired an Environmental Advisor who will be preparing for and overseeing environmental assessments and reviews within the Inuvialuit Settlement Region (ISR), including BREA. The critical responsibility of this position is for the management and coordination of internal environmental research, assessments, and reviews activities throughout the ISR focused on climate change, contaminants, environmental health, social, cultural and economic state of affairs and other related areas.

With the above position and gathering of social, cultural and economic base line data there will be a concerted effort going forward by Inuvialuit Institutions through the BREA Cumulative Effects Monitoring Working Group to establish a Cumulative Effects Monitoring Program within the ISR to allow for a method to identify impacts from resource development and other environmental changes.

The IRC organized a meeting in October 2011 with the Arctic Council Social Indicators Working Group who have developed Socio-economic indicators for Arctic Nations. IRC in partnership with the GNWT Bureau of Statistics presented to the Working Group existing data sets and a proposal to identify specific indicators that could be used to measure impacts from resource development. A Principal Investigator has been appointed to conduct studies under the 'Resources and Sustainable Development in the Arctic (ReSDA)' program. Meetings are planned with the Principal Investigator in early August 2012 to begin examining impacts from a mini-boom period (2001 to 2009) in the Mackenzie Delta and identify precisely what impacts occurred during that period and what are the major indicators to be used for future resource development projects.

Waste Management

The Waste Management Working Group will facilitate the development of a Regional Waste Management Strategy for the Inuvialuit Settlement Region. The Strategy would clearly map out regulatory requirements and jurisdiction, identify gaps, fully characterize current problems in waste management and present options for their resolution, provide guidance on best practices, and determine requirements for new or improved waste management processes / facilities including the identification of regional economic opportunities in the area of waste management.

Progress: This working group will begin its work in 2012-2013. It will build upon results of a study funded by the Environmental Studies Research Fund (ESRF) that was initiated in 2011-2012. The ESRF study will establish databases that include the types and estimated quantities of waste generated by various activities, and locations and capacities of regional waste management infrastructure. It will develop a model to forecast future waste streams in the region which will provide valuable input to the development of a regional waste management strategy. Initial scoping for the development of a regional waste management strategy will be conducted in 2012-2013 while the strategy will be developed from 2013-2015.

Community Outreach and Communications

BREA organized a number of community outreach events, from April 1, 2011 to March 31, 2012 to engage the Inuvialuit and Northerners in BREA, solicit their feedback on BREA initiatives and ensure that community priorities are being addressed.

BREA held a community tour in June 2011. All six communities in the Inuvialuit Settlement Region were visited. The tour provided an opportunity for community members to learn about BREA's planned research and working group activities, to provide feedback on these plans, and to highlight any areas of concern that were not being addressed by current plans.

BREA Day was held in Inuvik on December 5, 2011. Inuvialuit Game Council directors and alternates were present at the meeting, as well as members of co-management boards, and territorial and federal government employees. BREA researchers presented an overview of research plans, answered questions and received input from participants.

On February 27, 2012 the Honourable John Duncan, Minister of Aboriginal Affairs and Northern Development along with the Inuvialuit Game Council and the Inuvialuit Regional Corporation, announced that seventeen new research projects were initiated as part of the Beaufort Regional Environmental Assessment (BREA). [http://www.aadnc-aandc.gc.ca/eng/1330361772885]

The BREA project management office, as well as BREA research project and working group leads, have attended Game Council meetings to provide updates. In addition, BREA updates were presented to the Beaufort Sea Partnership meetings and Regional Coordinating Committee meetings on the Beaufort Sea Integrated Oceans Management Plan. A BREA presentation was given at the Canadian Association of Geographers Conference 2011.

Conclusion

Considerable progress has been made in BREA's first year with the establishment of research priorities and the selection of seventeen research projects. The six working groups have established plans to address key regional issues. Over the next three years, BREA project leads will conduct field studies, synthesize regional information, and ultimately build a regional knowledge base that will contribute to future management of oil and gas activities in the Beaufort. BREA offers an alternative forum to address regional concerns and research priorities raised by the Inuvialuit, Northerners, industry and regulators not easily dealt within a strictly regulatory approach. Government's investment in the region will increase confidence in its preparedness for oil and gas activities and reduce information gathering on project-specific reviews, while demonstrating its commitment to streamlining the regulatory process.

Annex – Governance and Partnerships

The Beaufort Regional Environmental Assessment is governed by a participatory governance structure that includes federal and territorial governments, industry, Inuvialuit, and academic organizations.

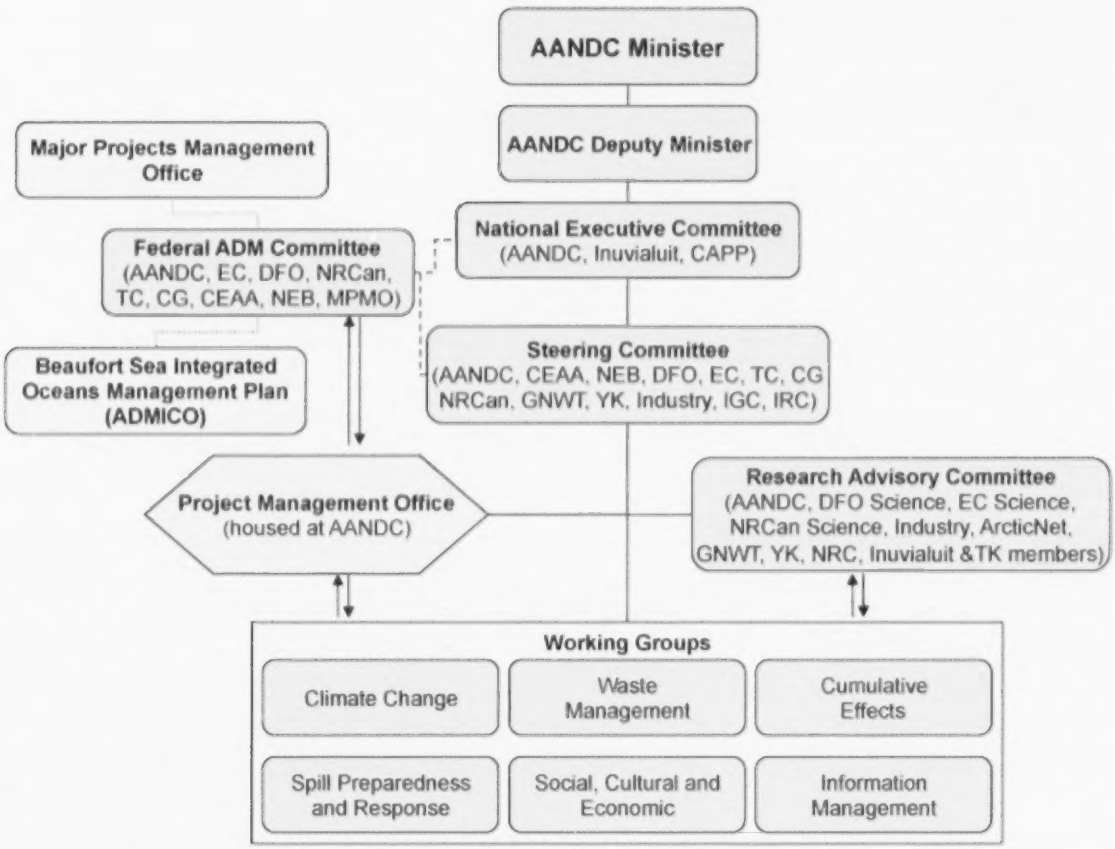
AANDC Minister
AANDC Deputy Minister
Major Projects Management Office
National Executive Committee (AANDC, Inuvialuit, CAPP)
Federal ADM Committee (AANDC, EC, DFO, NRCan, TC, CG, CEAA, NEB, MPMO)
Steering Committee (AANDC, CEAA, NEB, DFO, EC, TC, CG NRCan, GNWT, YK, Industry, IGC, IRC)
Beaufort Sea Integrated Oceans Management Plan (ADMICO)
Project Management Office (housed at AANDC)
Research Advisory Committee (AANDC, DFO Science, EC Science, NRCan Science, Industry, ArcticNet, GNWT, YK, NRC, Inuvialuit &TK members)
Working Groups
Climate Change
Waste Management
Cumulative Effects
Spill Preparedness and Response
Social, Cultural and Economic
Information Management

Figure 7. BREA Governance Structure. [Abbreviations: AANDC – Aboriginal Affairs and Northern Development Canada, CAPP – Canadian Association of Petroleum Producers, CEAA – Canadian Environmental Assessment Agency, CG – Coast Guard (Canada), DFO – Department of Fisheries and Oceans, EC – Environment Canada, GNWT – Government of Northwest Territories, IGC – Inuvialuit Game Council, IRC – Inuvialuit Regional Corporation, MPMO – Major Projects Management Office, NRC – National Research Council, NEB – National Energy Board, NRCan – Natural Resources Canada, PC – Parks Canada, TC – Transport Canada, TK – Traditional Knowledge, YK – Yukon Government]

Committee and Working Group members that have contributed to BREA

Thank you to those who have participated in making the first year of BREA a success.

Lawrence Amos	Sachs Harbour community member
Andrew Applejohn	Government of the Northwest Territories
Burton Ayles	Fisheries Joint Management Committee
Cheryl Baraniecki	Environment Canada
Steven Baryluk	Inuvialuit Game Council
Evan Birchard	Imperial Oil
Barrie Bonsal	Environment Canada
Carl Brown	Environment Canada
Leah Brown	Fisheries and Oceans Canada
Blythe Browne	Fisheries and Oceans Canada
Gilbert Brunet	Environment Canada
Geneviève Carr	Aboriginal Affairs and Northern Development Canada
Ray Case	Government of the Northwest Territories
Michel Chenier	Aboriginal Affairs and Northern Development Canada
Ian Denness	ConocoPhillips
Perry Diamond	Yukon Government
Bharat Dixit	National Energy Board
Jess Dunford	National Energy Board
Greg Finnegan	Yukon Government
Martin Fortier	ArcticNet
Mike Fournier	Environment Canada
Dave Fox	Environment Canada
John Fyfe	Environment Canada
Vic Gilman	Fisheries Joint Management Committee
Linda Graf	ConocoPhillips
Larry Green	Canada Coast Guard
Chantal Guenette	Canada Coast Guard

Shannon Jensen	Yukon Government
Jaideep Johar	Transport Canada
Amanda Joynt	Fisheries and Oceans Canada
Al Kennedy	Imperial Oil Resources
John Korec	National Energy Board
Ivana Kubat	National Research Council
Marc Lange	Aboriginal Affairs and Northern Development Canada
Phil Langille	Canadian Association of Petroleum Producers
Robert LeMay	National Energy Board
Bryan Levia	Yukon Government
Stephen Locke	Natural Resources Canada
Lisa Loseto	Fisheries and Oceans Canada
George McCormick	Aboriginal Affairs and Northern Development Canada
John McEwen	Aboriginal Affairs and Northern Development Canada
Ruth McKechnie	Aboriginal Affairs and Northern Development Canada
Pippa McNeil	Yukon Government
Margaret McQuiston	National Energy Board
Humphrey Melling	Fisheries and Oceans
Joanne Monroe	Canada Coast Guard
Gavin More	Government of the Northwest Territories
John Noksana	Tuktoyaktuk Hunter and Trapper Committee
Aynslie Ogden	Yukon Government
James Oliver	Canadian Environmental Assessment Agency
Todd Paget	Government of the Northwest Territories
Tara Paull	Aboriginal Affairs and Northern Development Canada
Pierre Pellerin	Environment Canada
Will Perrie	Fisheries and Oceans Canada
Nelson Perry	Parks Canada
Mike Peters	Canadian Association of Petroleum Producers
Jon Pierce	Canadian Environmental Assessment Agency
Frank Pokiak	Inuvialuit Game Council
Cynthia Pyc	BP
Don Reed	Aboriginal Affairs and Northern Development Canada
Jim Reist	Fisheries and Oceans

Pamela Romanchuk	National Energy Board
Wade Romanko	Environment Canada
Beverly Ross	Fisheries and Oceans Canada
Simon Routh	Inuvialuit Regional Corporation
Fons Schellekens	Natural Resources Canada
Eric Schroff	Yukon Government
Andrea Short	Canadian Environmental Assessment Agency
Brian Sieben	Government of the Northwest Territories
Gerry Simon	ConocoPhillips
Bob Simpson	Inuvialuit Regional Corporation
Norm Snow	Joint Secretariat
Gary Sonnichsen	Natural Resources Canada
Robert Steedman	National Energy Board
Reagan Stoddart	Imperial Oil
Mary Tapsell	Government of Northwest Territories
Dave Tilden	Environment Canada
Garry Timco	National Research Council
Larry Trigatti	Canada Coast Guard
Lisa-Marie Vaccaro	Environment Canada
Brenda White	ConocoPhillips
Jennifer Wyatt	Chevron
Robert Young	Fisheries and Oceans Canada